CRUBOTICS

RANGER TEAM

PENSACOLA CATHOLIC HIGH SCHOOL
3043 W Scott St
Pensacola, FL 32505
USA

Company Members:

KUSH WELLS
Chief Executive Officer, Pilot

LEXI FOLAND
Chief Financial Officer, Head of Marketing

ALEX CHE
Chief Operations Officer, Lead Programmer

LUKE FOSTER
Float Engineer

BRANDON HOPPE
Float Engineer, Safety Officer

ALOYSIUS LONDON
Assistant Designer

MAC MCKINLEY
CAD Modeler

OBIE POWELL
Lead Builder

GRANT ROBERTSON
CAD Modeler

TYLER RUBLE
Electrician

CAROLINE STRUCK
Head of Media

QUENTIN WRIGHT
Lead Programmer

Mentors:

DANA LUPTON
AP Chemistry Teacher | Mentor

ERIC REQUET
AP Calculus Teacher | Mentor

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Abstract

The Pensacola Catholic High School Crubotics Team contains 14 members that specialize in the building, programming, piloting, and marketing tasks required for the construction and promotion of remotely operated vehicles. These skills were used to create the Automated Repair Reconnaissance Explorer (A.R.R.E.) for the 2023 MATE Competition. A.R.R.E. features six motors (four horizontal, two vertical); since the horizontal monitors are oriented at a 45-degree angle, the ROV uses omnidirectional movement and changes in pitch to suit many tasks and currents.

A.R.R.E. contains a tilt-mount camera to provide wide-range views; this feature proves especially useful in collecting visual data during Task 2. This camera sits inside a 100 mm watertight enclosure, which additionally contains the computing software: a raspberry pi, servo motors, wiring, and a terminal. One of these servo motors controls A.R.R.E.'s 3D-printed mechanical claw, used for gripping items. Contrarily, the ROV's stationary claw, resembling a hook, does not use a servo motor and instead dislodges items.

To ensure safety for wildlife and operators, the ROV is equipped with pressure-relief valves, prop shrouds, and motor shields, among others. All of the aforementioned features allow A.R.R.E. to complete the tasks in the MATE Competition; however, Crubotics strove to design an ROV that would also function well in real-world missions like examining ecosystem health, connecting power lines, and removing harmful environmental factors.

Figure 1. The 2022-23 Crubotics Ranger Team (left to right):

First Row: Caroline Struck, Lexi Foland, Alex Che, Aloysius London

Second Row: Mac McKinley, Kush Wells, Obie Powell, Quentin Wright, Luke Foster

Third Row: Brandon Hoppe, Grant Robeertson

Not Pictured: Tyler Ruble

Project Management

COMPANY OVERVIEW

Crubotics contains 14 members: 2 teacher mentors, 7 high school seniors, 2 juniors, and 3 sophomores. Each member's role corresponds to their respective skillsets; for more information, see Appendix A.

SCHEDULING

From August to December of 2022, Crubotics scheduled team meetings biweekly (Tuesdays and Thursdays at 3:00 PM) to support consistent work on the ROV. Starting in January, members began attending meetings on additional weekdays to ensure deadlines were met. To stay on track, the team utilized many communication channels: an active email chain, a group chat, and a whiteboard in the lab with due dates and goals, to name a few.

In terms of problem-solving, Crubotics follows the mantra: "don't bring me a problem, bring me a solution." When problems arose, team members 1) identified the root cause of the issue, 2) developed multiple solutions, and 3) picked the most effective and financially feasible option. For example, when the servo motors for the mechanical claw fried a week before Regional Championships, programmers and electricians realized 1) there was a wiring issue, 2) the fried motors could be replaced, substituted, or not used, and 3) the most feasible solution was to use the stationary claw as the main manipulator during the Regional Competition.

Figure 2. The in-lab whiteboard detailing due dates, timelines, and motivational countdowns.

Design Rationale

ENGINEEERING PROCESS

The company's engineering process developed in tandem with the 2022-23 school year, beginning with general brainstorming and transitioning to building, modifying, and testing the ROV during later months.

August - September 2022, Whiteboard Brainstorming: During the "Whiteboard Phase," team members discussed pros and cons of the previous design used in the 2022 MATE Competition. Drawings, proposals, and parameters were written on a whiteboard in the Crubotics lab. The team drew rough sketches to account for specific modifications once the mission tasks were released.

October - November 2022, Modeling Phase: Using the application Fusion360, Crubotics transformed whiteboard ideas into computer aided designs to solidify general ideas and begin simulated buoyancy testing.

December 2022, Finalizing Models: After receiving the mission tasks, CAD models were finalized and the team compiled a list, sectioned by departments, of all necessary materials and costs.

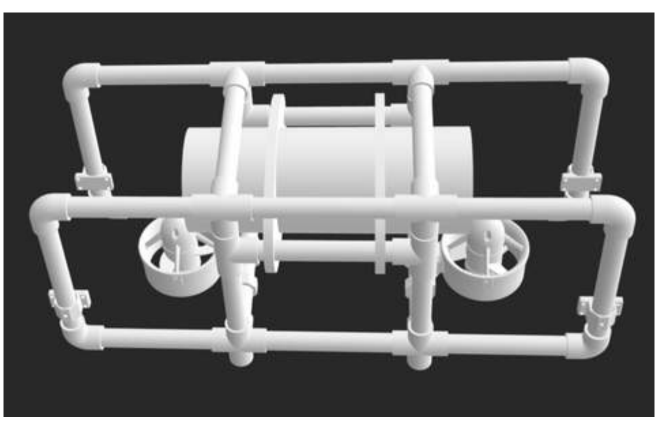


Figure 3. An early CAD of A.R.R.E., created in Fusion360, to visualize the general structure and vertical thruster placement.

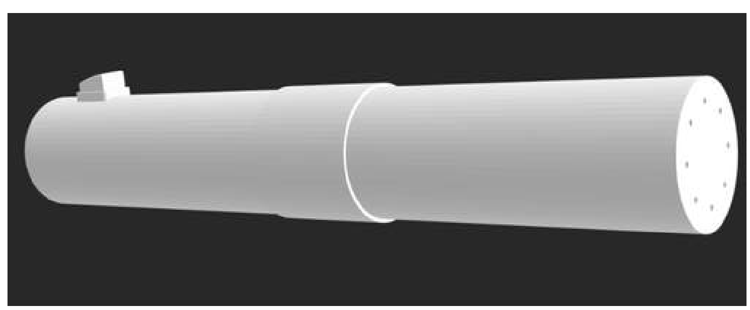


Figure 4. An early CAD of the BGC Float, created in Fusion 360, to visualize the general shape and location of the on/off switch.

The release of the mission tasks finalized the team's decision to transition from a hydraulic claw to a mechanical/stationary claw duo, which better suits aspects of Task 1 like removing biofouling, applying coral treatment, and arranging solar panels. The need for strong visual range in Task 2 spurred consideration of a tilt-mount camera, which would allow operators to more effectively count frogs, survey diseased coral, and assess seagrass growth.

Figure 5. A vacuum pump used to pressure test the Blue Robotics electronics enclosure.

January - March 2023, Building Phase: The general frame and structure of A.R.R.E. was built, and modifications were added as needed. Testing, especially on buoyancy and motors, was performed.

April 2023, Final Details and Testing: The team transitioned from heavy construction to heavy testing, focusing on only adding small modifications when necessary. This process included: dunk tests, buoyancy tests, pressure/leak tests, and motor tests.

VEHICLE STRUCTURE

Crubotics chose a 0.5 inch PVC frame for A.R.R.E.; as opposed to other options, the material is cost-effective, lightweight, and drop-resistant. After considering the octagonal structure used in previous years, the team opted for a compact rectangular frame to allow increased mobility, protection, and support. To keep pressure from building within the PVC frame, small holes were drilled into the material.

PROPULSION

Positioned on team-designed motor mounts, six thrusters are used, two vertical T200s and four horizontal Diamond Dynamics TD 1.2s, the latter of which are oriented at a 45 degree angle. This allows the ROV to move sideways, forwards, and backwards while also enabling changes in angle of attack; A.R.R.E. can adopt a pitch that may benefit its efficiency in completing the task at hand.

The vertical T200s draw considerably more amperage per unit than the horizontal Diamond Dynamics TD 1.2s (5 Amps compared to 1.5 Amps); Crubotics decided that since there were only two vertical motors, they could draw more amperage, especially considering the vitality of vertical motion and pitch to observing frogs along the transect in Task 2. Only 2 T200s were used as opposed to 4 DD TD 1.2s because the T200s are considerably more expensive.

Figure 6. One vertical T200 thruster and two horizontal (and angled) Diamond Dynamics thrusters.

INTERNAL AND ELECTRICAL STRUCTURE

Centered within the frame is a 100 mm watertight acrylic enclosure that houses all electrical components. A.R.R.E.'s thrusters are controlled by electronic speed controllers (ESCs) connected to a Blue Robotics Navigator Flight Controller paired with a Raspberry Pi 4 Model B. The Raspberry Pi communicates with ground control software (custom-made or off-the-shelf) via MavLink over Ethernet to control various vehicle functions. This design allows for a thinner tether (containing only one 14/2 gauge for power and a UTP cable for communication); this both increases maneuverability and decreases the amount of expensive wire required. The H.264 video output of the low-light camera mounted near the front of the enclosure is streamed over UDP to the topside computer.

Figure 7. A topside view of A.R.R.E.'s electrical enclosure; the Raspberry Pi is covered with a black navigator shield and connected to an Ethernet and UTP cable.

Within the enclosure, Crubotics placed leak sensors in ideal locations that connect to the flight controller. If a leak is detected, the ROV provides a warning or automatically disarms itself. This maximizes safety for people and marine life near the ROV and helps to prevent costly damage to electronics. In addition to leak sensors, the flight controller has one six-axis IMU and two six-axis magnetometers for redundancy which enable the ROV to operate semi-autonomously. Mounted outside of the enclosure is a high-precision depth sensor that allows A.R.R.E. to maintain its depth while moving horizontally.

MANIPULATORS - MECHANICAL AND STATIONARY CLAWS

A.R.R.E. uses two manipulator claws, one stationary and one mechanical. The stationary claw, which is attached on the starboard side, resembles a hook and is used for dislodging items like biofouling in Task 1 by pulling or pushing (when the thrusters propel the ROV as needed).

The mechanical claw, on the port side, is 3D printed and can be used to grip objects, making it advantageous over the stationary claw during tasks like applying UV treatment to coral or mooring panel arrays to anchor points. Additionally, the two claws are approximately 19 cm apart; thus, they can be used to gather a rough estimate of object size.

Figure 8. The stationary claw (left) and mechanical gripper (right).

TETHER SYSTEM

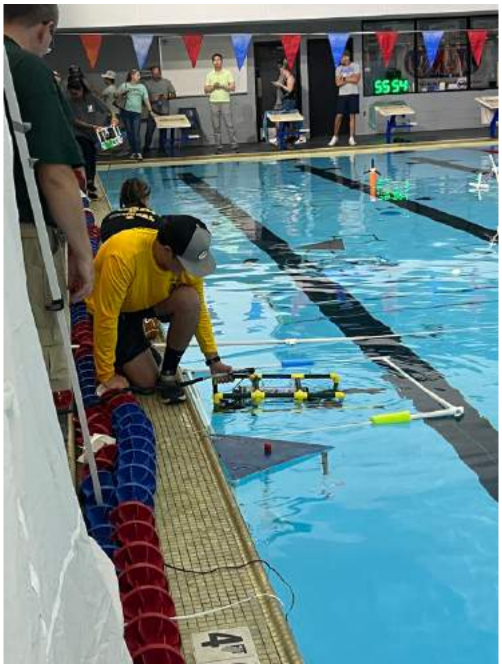


Figure 9. Lead Builder Obie Powell managing the tether at North Gulf Coast Regionals.

The 25 m tether, consisting of two black cords (one carrying power, one carrying Ethernet signals), is mounted through two holes in the 100 mm acrylic enclosure. A bridle is installed with the mount to transfer strain to the PVC frame when the ROV is lifted (as opposed to the acrylic enclosure). The rest of the tether is sheathed and stretches to the control box.

Crubotics developed a tether management protocol to aid in product demonstration; if the pilot wishes for the ROV to be pulled in tighter or less tether to be left slack, he/she yells “Tether in!” to the tether manager. Conversely, if the pilot wishes for more slack/freedom, he/she yells “Tether out!” The tether is typically managed by Lead Builder Obie Powell.

BUOYANCY AND BALLAST

After running buoyancy simulations in Fusion360, Crubotics predicted A.R.R.E. would be positively buoyant. In-house testing in April confirmed this assumption. The team decided that neutral buoyancy would cooperate most effectively with the motion required to complete mission tasks.

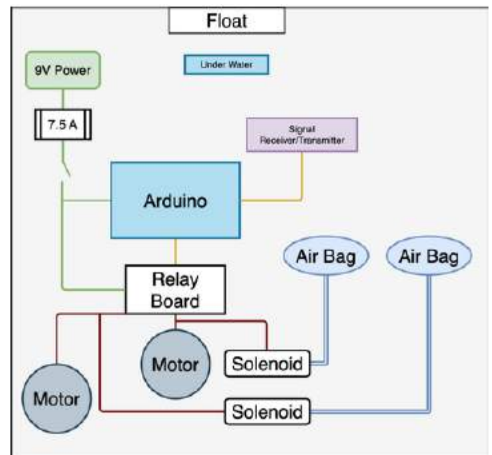
Consequently, Crubotics added lead weights as ballast to specific internal sections of the frame to 1) evenly distribute weight and 2) prevent the lead weights from sliding around inside the PVC.

NON-ROV - FLOAT RATIONALE

Crubotics' 2023 BGC float consists of a central cylinder of 2 in PVC modified to house an air inflation system; this system moves air from one bladder inside the housing of the float to an external bladder located above the housing. This changes the buoyancy of the float, allowing it to move vertically according to its programming.

The internal system is composed of 4.5-volt peristaltic pumps, coupled with 9-volt solenoid valves to move the air to and from the bladders through 6 mm polyurethane tubing. All electronics are powered by a 9-volt alkaline battery and regulated by a 7.5 amp fuse with a calculated draw of 5.24 Amps. The onboard control system consists of an Arduino Uno running on a timer which communicates with the topside computer using a pair of HC-12 transceiver modules.

The user turns on the float via a waterproof switch on the exterior. From there, the float runs autonomously. There is a carry handle on the upper exterior of the float to assist in deploying/retrieving and to provide a safe area to hold. In the case of over-pressurization, there is a pressure release valve to prevent dangerous situations for divers and sea life.



Calculations

Device	Quantity	Current Drawn (Amps)	Total Current (Amps)
Arduino	1	.8	.8
Relay	2	.002	.004
Motor	2	.65	1.3
Solenoid	2	.65	1.3
Signal Receiver/ Transmitter	1	.013	.013
Total Current (Amps)			3.417
Overcurrent Protection Factor(%)			5.13
Fuse (Amps)			7.5

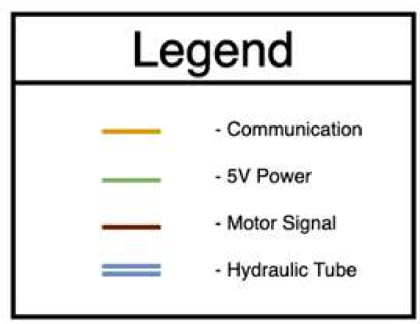


Figure 10. The System Integration Diagram for the BGC Float.

BUILD VS. BUY

Crubotics utilized 3D-printers to customize specific elements of the ROV; this additionally increased cost-effectiveness. 3D-printed, customized features include the mechanical claw, the motor mounts, the thruster shrouds, the circuit board supporting electronics, and the circuit board's terminal. Creating specifically designed parts allows the ROV to remain safe for wildlife in a real-world situation similar to Task 2 and to manipulate objects easily in a situation similar to Task 1.

However, team members knew investing in crucial features of the ROV was a worthwhile cause; consequently, the following aspects were purchased: Blue Robotics 100 mm waterproof acrylic enclosure, Blue Robotics T200 thrusters, Diamond Dynamics TD 1.2 thrusters, Blue Robotics tilt-mount camera with electronic speed and flight controllers, and multiple safety features such as quick-disconnect cables.

The investment in these purchased items ensures that the ROV can function safely and successfully in all tasks and missions, providing protection from leaks and building pressure.

NEW VS. REUSED

During the Whiteboard Phase, team members considered which features of the 2021-22 ROV should be included this year and which should be scrapped. The transition to a rectangular frame was a new decision; however, Crubotics reused 0.5 inch PVC pipes to create this structure. Similarly, the previous year's stationary claw remained on the ROV, but the hydraulic claw was traded for a new 3D-printed mechanical gripper. The reuse of PVC keeps A.R.R.E. within the constraints of ROV weight, and the recycled stationary claw can dislodge items in Task 1.

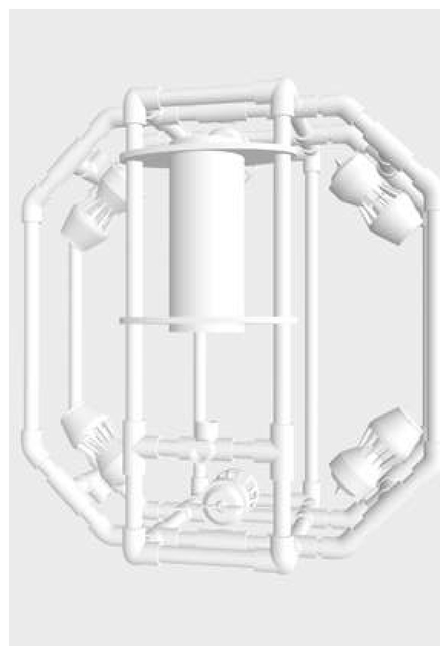


Figure 11. A computer-aided design of the 2021-22 ROV used in the MATE Competition.

For more information about the ROV's systems, see Appendix B.

Safety

The central controller of all electrical components is a raspberry pi; it is protected by a 100 mm waterproof, acrylic enclosure from Blue Robotics. This enclosure features a pressure relief valve rated up to a 950 m depth. Additionally, wetlink penetrators are used to ensure no leaks occur. Any electrical connections outside of the enclosure are rated waterproof to a depth of 4 m.

The Anderson Powerpole and its fuse are within 30 cm of the DC power supply running through the control box, and AC power is also used in the box to power the computer. The control box itself has been waterproofed to a depth of 4 m. The sheathed tether, which stretches from the box to the ROV, is equipped with strain-relief clamps to prevent damage to A.R.R.E.'s waterproof enclosure and the box; in event of an emergency, the tether can also quick-disconnect from the control box.

Calculations of amperage were performed based on the electronics used; the Fuse Overall Percentage falls within the range of the 25 amp fuse used.

Device	Quantity	Current Drawn (Amps)	Total Current (Amps)
Raspberry Pi	1	.323	.323
T200 Motors	2	5	10
Motors	4	1.5	6
Servos	2	.015	.03
Camera	1	.14	.14
Total Current (Amps)			18.493
Fuse Calculations (Amps)			24.740
Fuse Calculations (Amps)			25

Figure 12. Fuse calculations used for confirming electrical safety.

The ROV's 2 vertical thrusters are 2 Blue Robotics T200's, running on 5 Amps each; the 4 horizontal thrusters run on 1.5 Amps each. To protect wildlife and handlers, each thruster is covered on the front and back with shrouds. Laser-cut acrylic supports the waterproof enclosure, and 3D printed mounts support the motors. All edges and surfaces are smooth within acceptable safe standards.The laptop, Ethernet cable and adapter, and controller are all located in the waterproof control box.

SAFETY RATIONALE

Crubotics follows the belief that each member is the other's keeper; if an unsafe activity is occurring, it is the mandatory responsibility of any nearby individuals to identify and stop these activities.

While working in the lab, all team members must pull back long hair, wear closed-toed shoes, and remove any dangling jewelry. Additionally, members use a safety checklist before product demonstration, which can be found in Appendix C. Crubotics also has a Job Safety Analysis, which can be found in Appendix D.

Figure 13. 3D-printed shrouds are used to protect wildlife and operators from thruster motion.

Critical Analysis

PROTOTYPING

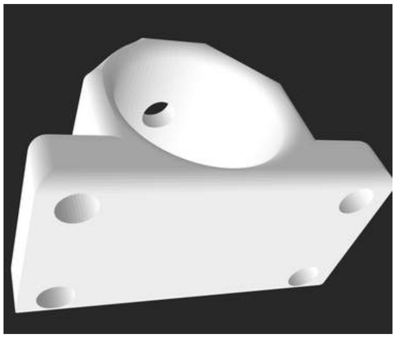


Figure 14. A motor mount designed in Fusion360.

Computer-aided designs of A.R.R.E.'s overall structure were created using Fusion360; the application allowed modelers to test buoyancy and hydrodynamics. Computer-aided designs of A.R.R.E.'s overall structure were created using Fusion360, which allowed buoyancy and hydrodynamics testing.

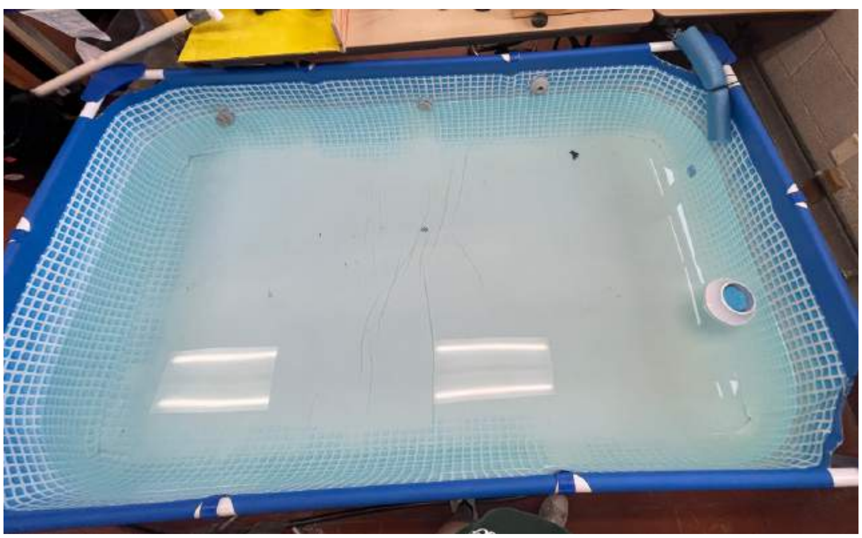
The chosen rectangular prism design was seen to be positively buoyant, but rather than potentially sacrifice support and mobility, the team opted to use lead weights as ballast. Additionally, more CADs were created to model any 3D-printed aspects of the ROV, including motor mounts and claw mounts.

TESTING

Crubotics follows the following methodology: test, assess, modify, test. First, an aspect of the ROV, such as buoyancy, was selected for testing. Team members used an in-lab mock pool to observe the nature of A.R.R.E. at rest in water. Then, team members would assess the results of the test; as predicted in Fusion360, A.R.R.E. was positively buoyant.

The team concluded that neutral buoyancy would most effectively cooperate with the control system. Consequently, the ROV was modified by adding lead weights as ballast. Then, the buoyancy test was run again in the pool. Crubotics performed as many iterations as needed to obtain the desired result.

The aforementioned methodology was used to test buoyancy, controls, propulsion, wiring, waterproofing, and pressure-resistance.



Figures 15 and 16. The in-house pool used for various types of testing. It is approximately 2 m by 4 m.

TROUBLESHOOTING

Troubleshooting served as part of the "modify" phase of the testing methodology. Upon encountering a problem during testing, team members first composed a list of possible sources of the issue. After ranking the sources from least to most likely, members went through each source to see if the corresponding feature of the ROV was working as intended.

Figure 17. Lead weights used. to achieve neutral buoyancy.

Once team members discovered an area that needed improvement, the lab whiteboard was used to consider possible solutions (unless there was a quick fix to the issue, such as a coding error). These solutions were then evaluated based on cost-effectiveness, likelihood of success, and time constraints.

Figure 18. The stars represent the final placement of lead weights within the PVC frame.

Continuing with a previous example, Crubotics used troubleshooting when adding ballast to the ROV. The lead weights kept sliding around inside the PVC frame during testing, creating uneven weight distribution. The team considered possible solutions:

Buying more specialized ballast that wouldn't slide as much, which had a high likelihood of success but was neither cost-effective nor time-efficient.
Searching the lab/local sources for another form of ballast, which was cost-effective but lacked a high likelihood of success and time-efficiency.
Locating a specific area inside the ROV frame that would evenly distribute weight AND reduce sliding; while this option could potentially be less time-efficient, it was cost-effective and had a high likelihood of success.

After comparing the pros and cons of each solution, the team chose option 3 and successfully distributed the lead weights while neutralizing the buoyancy.

Acknowledgements

First and foremost, Crubotics would like to thank MATE II for holding the 2023 ROV Competition; our team is grateful for the exposure to engineering innovations, product presentations, and company management duties. Additionally, we appreciate Dauphin Island Sea Lab for hosting the North Gulf Coast Regional Competition and providing extensive feedback to prepare us for international competition.

We'd also like to thank the following sponsors and benefactors, without whom none of this would have been possible: the City of Pensacola, Blackwater River Tools, Main Street Construction, Pensacola Energy, the Savoy Family, the Requet Family, the Hoppe Family, the Foland Family, and Bubba's 33. Additionally, we owe a huge thank you to both Hour-A-Thon fundraising and all donors who participated in the event.

Lastly, we would like to give a shout-out to our mentors, Mrs. Dana Lupton and Mr. Eric Requet, who put time and effort into overseeing our work while still juggling other responsibilities as full-time teachers. None of this would be possible without you!

References

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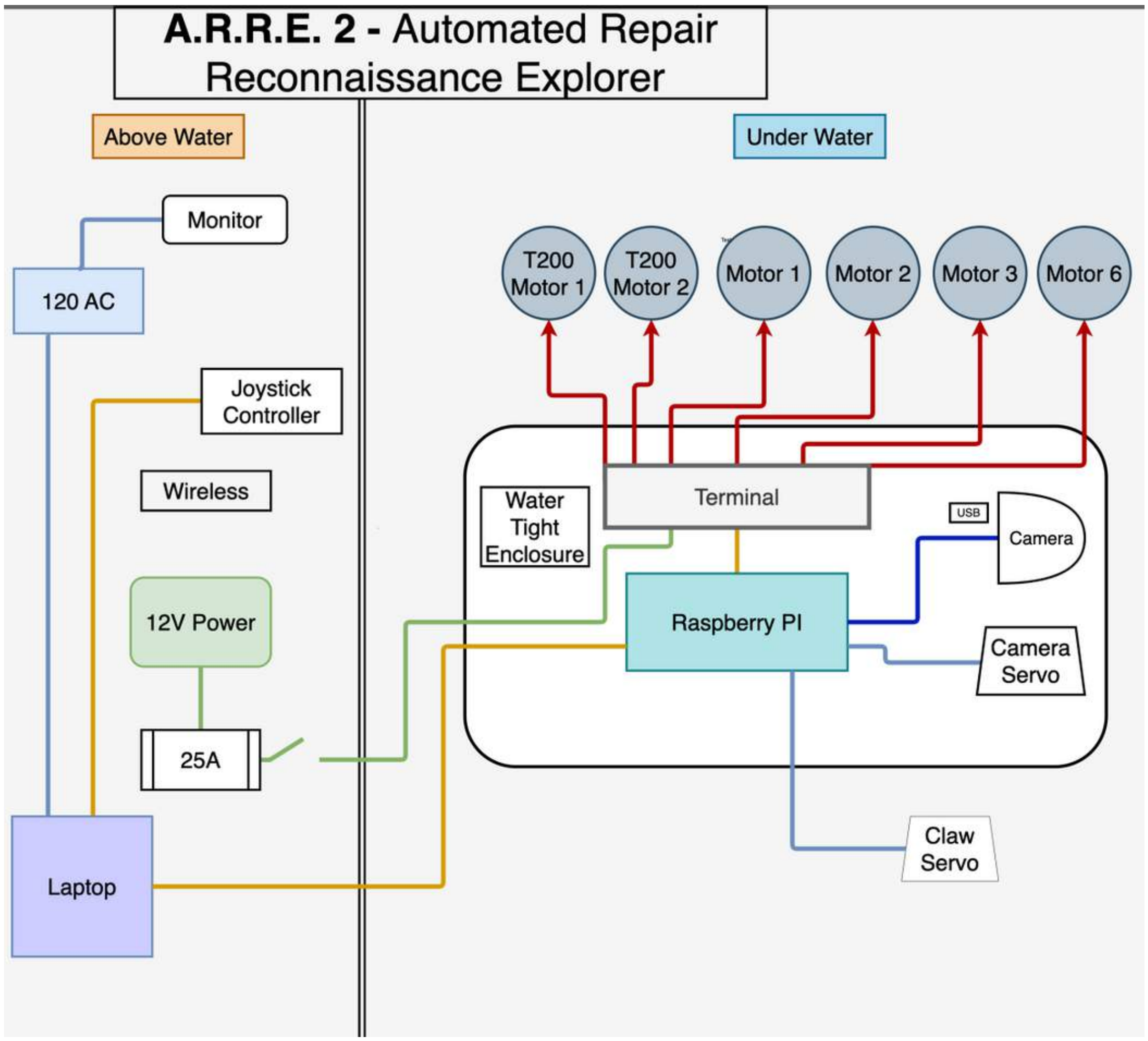
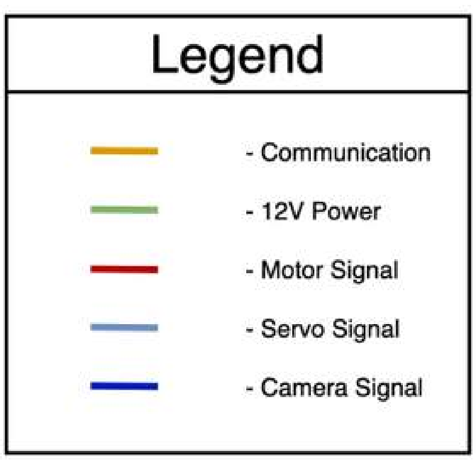
APPENDIX A: JOB DESCRIPTIONS

Kush Wells CEO/Pilot	Leads team meetings and presentations; oversees all modifications; pilots A.R.R.E.
Lexi Foland CFO/Head of Marketing	Keeps track of all financial transactions/budgets; composes technical documentation; controls social media accounts
Caroline Struck Head of Media	Photographs product development and demonstration ; composes technical documentation
Mac McKinley and Grant Robertson CAD Modelers	Design 3D models in Fusion360 application; test said models via simulations; propose build modifications
Quentin Wright Lead Programmer	Writes code for ROV and non-ROV control; oversees electronics installation
Alex Che COO/Lead Programmer	Oversees day-to-day and minor operations in the lab; writes code for ROV and non-ROV control
Tyler Ruble Electrician	Manages wiring and troubleshooting on ROV and non-ROV devices
Luke Foster Float Engineer	Designs the BGC float with modelers; oversees general production of BGC float
Aloysius London Assistant Designer	Contributes to discussion and modification of ROV; proposes adaptations to mission tasks
Obie Powell Lead Builder	Constructs and handles frame of ROV and non-ROV devices; manages tether
Brandon Hoppe Safety Officer	Performs regular safety checks during construction and demonstration





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T200 Motors	2	5	10
Motors	4	1.5	6
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Camera	1	.14	.14
Total Current (Amps)			18.493
Fuse Calculations (Amps)			24.740
Fuse Calculations (Amps)			25

APPENDIX C: SAFETY CHECKLIST

Shop Safety:		Deployment Safety:	
Are the emergency eyewash, fire extinguisher, and first-aid kit ready for use?		Are all thruster shrouds securely fastened BEFORE operation?	
Is long hair tied back?		Is long hair tied back?	
Is dangling jewelry removed from wrists/neck/et cetera?		Is dangling jewelry removed from wrists/neck/et cetera?	
Is an adult/mentor present?		Is an adult/mentor present?	
Are all involved members wearing proper PPE for the construction activity?		Has the pressure-relief system been tested recently using the vacuum pump?	
Are all involved members actively paying attention?		Power up ROV; are there any warning indicators?	
		Are the leak sensors operational?	
		Is the tether relief system operational?	

Job Safety Analysis

PCHS Crubotics "Building Efficiently, Restoring Effectively"

Ranger Class ROV

Task		Hazards	Controls
1.	Moving equipment to deck	Damaging materials Dropping ROV	Have multiple people moving materials Have ROV secure and tether wrapped around spool
2.	Setting up controls	Tangling wires	Keep wires neatly organized Have all ports and cables labeled
3.	Placing ROV in pool	Non-waterproof wires potentially exposed	Double-check all exposed wires to make sure they are waterproof. Any non-waterproof wires need to be placed inside the frame.
4.	Controlling ROV	Sharp edges damaging surroundings	Put hot glue on all zip tie edges and smooth out other sharp edges
5.	Removing ROV	Tangling Tether	Wrap tether around spool after removing from pool
Required Training: Safety course		**Required Personal Protective Equipment (PPE): Protective Eyewear**	

Other: None

Contributors: Crubotics: Safety Officer Brandon Hoppe

Created: April 2023

School Name: Pensacola Catholic High School Mentor: Mrs. Dana Lupton, Mr. Eric Requet Reporting Period: From 12/1/2022 to 5/24/2023				
Income:				
Source		Type		Amount (S)
Rollover		Rollover		1,985.00
Expenses:				
Category	Type	Examples	Projected Cost (S)	Budgeted Value (S)
Housing	Purchased	Blue Robotics enclosure, flanges	400.00	400.00
Frame	Re-used	PVC pipe, connectors	50.00	-
Electronics	Purchased	Raspberry pi, cable connectors	450.00	450.00
Camera / Video	Purchased	Tilt-mount camera, flight controller	530.00	530.00
General	Purchased	Poster, printing costs, uniforms	800.00	800.00
Propulsion	Purchased	T200 Motors, Diamond Dynamics Motors	950.00	950.00
Travel	Purchased	Transport and housing to competitions	17,000.00	17,000.00
Float	Purchased	Pumps, bladders, receivers	200.00	200.00
Post-Regional Modifications	Purchased	Any repairs/add-ons if going to Worlds	300.00	300.00
		Total Income:		1,985.00
		Total Expenses:		20,930.00
		Total Expenses - Reuse:		20,880.00
		Total Fundraising Needed:		18,895.00

APPENDIX F: PROJECT COSTING

School Name: Pensacola Catholic High School
Mentor: Mrs. Dana Lupton, Mr. Eric Requet
Reporting Period: From 12/1/2022 to 5/24/2023

Date	Type	Category	Description	Amount ($)	Running Balance ($)
12/1/22	Purchased	Electronics	Bulkhead cable connector/disconnect	(28.50)	(28.50)
12/1/22	Purchased	Housing	BlueRobotics enclosure (including flanges, tube, pressure-resistance valve)	(402.00)	(430.5)
12/5/22	Purchased	Propulsion	BlueRobotics T200 motors, ESC, penetrator, assembly block, BlueRobotics wetlink penetrators, vacuum plug kit, M10 vents/plugs	(670.00)	(1100.50)
12/15/22	Income	Fundraiser	Christmas Ornament Market	425.00	(675.50)
12/16/22	Purchased	Camera / Video	Tilt-mount camera w/ flight controller from BlueRobotics	(524.00)	(1199.50)
12/16/22	Re-used	Frame	PVC pipe, fittings, elbows, stationary claw	50.00	(1199.50)
12/18/22	Income	Sponsorship	Pensacola Energy	500.00	(699.50)
12/20/22	Purchased	General	Team uniforms	(632.00)	(1131.50)
12/20/22	Income	Dues	Team Contributions/dues	700.00	(631.50)
12/27/22	Income	Sponsorship	Main Street Construction	300.00	(331.50)
12/27/22	Re-used	Float	Arduino Uno (2)	90.00	(331.50)
12/27/22	Purchased	Float	Bladder, 6 mm tubing, transmitter/receiver, PVC, pumps	(113.86)	(445.36)
12/28/22	Purchased	Electronics	GearIT 18 gauge wire, braided wire harness, YETOR waterproof connectors	(49.00)	(494.36)
12/30/22	Purchased	Electronics	Raspberry pi, electrical junction box, strain relief connectors, Trymag magnets, CableCreation RJ45 ends, Vacuum Pump Tester	(299.36)	(793.72)
12/30/22	Purchased	Propulsion	DiamondDynamics 1.2kg Underwater Thrusters	(256.00)	(1049.72)
1/5/23	Purchased	General	Cat 5e Ethernet Cable, marketing printing	(214.48)	(1264.20)
1/10/23	Income	Sponsorship	Requet/Hoppe/Savoy/Foland Family	1520.00	255.80
2/6/23	Income	Fundraiser	Bubba's 33 Restaurant	125.00	380.80
5/4/23	Purchased	Travel	Airfare/Hotel for 14 (Internationals)	(16,300.00)	(15,919.20)
5/6/23	Purchased	PR Mod.	New servo motors, wiring, repair parts	(290.79)	(16,209.99)
5/23/23	Income	Fundraiser	Hour-A-Thon Phone Call Fundraiser	4,100.00	(12,109.99)
				Total Raised ($):	7,670.00
				Total Spent ($):	(19,779,99)
				Final Balance ($):	(12,109.99)

*This is the budget as of 5/24/2023; additional fundraising is planned for later dates to get to Internationals, so the final balance may be truly lesser.